Relevant Models for Exposure Assessments of VCCEP Chemicals

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EPA/ACC Technical Workshop

for

Voluntary Children's Chemical Evaluation Program

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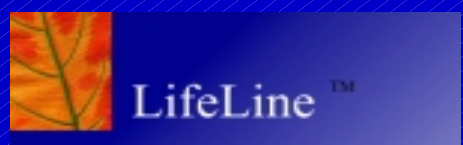

Topics

- Children's Exposures
- Types of models
- History of models
- Review/overview of existing models
- Relevance of existing models

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Children's Exposures

- Diet, tapwater, inhalation
  - Higher intake rates
  - Different foods
- Unique pathways
  - Soil ingestion
  - Hand to mouth
  - Toys
- Activity patterns
  - Different microenvironments
  - More time in the home

Modeling Children's Exposures

- Age-specific data on
  - Intake of food, water and air
  - Physiology
    - Body weight and surface area
  - Behaviors
    - Mouthing behaviors
- Microenvironments
  - *In Utero*
  - Residence
  - Daycare, preschool, schools
  - Sports
  - Toys

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Two Types of Models

- Models created for the sake of efficiency
  - Automate calculations that replace pen and paper/spreadsheets
  - Reduce costs, improve accuracy and consistency
  - Develop when one set of scenarios and assumptions are used repeatedly in multiple assessments
    - RECRA/CERCLA Sites and PMNs
- Models created to generate data that can not be developed in any other way
  - Air dispersion and ground water models
  - Models of interindividual variation and uncertainty
  - Aggregate and cumulative exposures

History/Motivation for Model Development

- CAA-Air Toxics
  - Dispersion Modeling
  - Air toxics in microenvironments
  - Aggregate assessments for the assessment of residual risks
- TSCA/EU requirements
  - Product stewardship
  - Consumer (home and commercial)
- RCRA/Superfund/UST
  - Thousands of sites
- FIFRA/FQPA
  - Product stewardship
    - **Dietary**
    - **Aggregate/Cumulative**

Air Models

- Point source releases
  - TOXST/LT
- Indoor air (Source to air)
  - CONTAM
  - IAXQ-Excellent source models
  - RISK
  - MCCEM-Muti-room
- Microenvironment (Indirect) Models
  - CPIEM
  - TEM-Tapwater
  - NEM/pNEM/HAPEM-MS/SHAPE/SCREAM
  - TRIM/APEX (2.0)

Air Models

- Screening
  - EFAST
  - MCCEM
- Refined source modeling
  - IAXQ
  - Promise (solvents)
- Refined exposure (people)
  - CPIEM
  - APEX (2.0)
- Refined water models
  - TEM
- Aggregate
  - APEX ?
  - ?

Consumer/Commercial Models

- EFAST
- USES/EUSES
- ChemSTEER
- CONSEXPO-3
- PROMISE-Probabilistic capabilities

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Consumer Models

- Screening
  - EFAST
  - CONSEXPO-3
  - USES/EUSES
  - ChemSTEER
  - PROMISE-Probabilistic capabilities
- Refined
  - CONSEXPO
  - PROMISE
- Aggregate
  - ?

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RCRA/Superfund/Industrial Sites

- Driven by the need of efficiency
  - Thousands of sites
  - Consistent guidance (RAGS)
- Perform tiered analyses
  - Site specific data
  - deterministic and probabilistic

Site Oriented Models (Waste/Industrial site)

- API DSS
- CalTOX
- MEPAS
- MMSOILS
- RISK*ASSISTANT
- SmartRISK

RCRA/Superfund/Industrial Sites

- Screening
  - EFAST
  - CalTOX
  - APIDSS
  - SMARTRisk
- Refined
  - CalTOX
- Aggregate
  - ?

General Diet Models

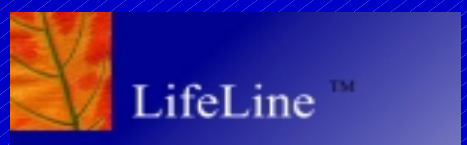
- Created to meet the need to regulate pesticides under FIFRA
- Deterministic and probabilistic versions
- Not intended to address local sources of contamination
  - Home gardens
  - Local contamination of food

General Diet Models

- Based on USDA Continuing Survey of Food Intakes by Individuals (CSFII)
- Allows the user to enter data on chemical concentrations in specific crops
- Models use CSFII and food recipes to estimate the daily dose from diet for general population and subpopulations of adults and children

General Diet Models

- DEPM (available from EPA-ORD)
- DEEMS™ (limited availability, not transparent)
- CARES (under development by ACPA 2002)
- SHEDS-Pesticides (under development by EPA ORD, 2002/3)
- LifeLine™ Version 1.1 (ask me for a copy)



General Diet Models

- All models can be run in screening modes and in refined assessments
- Excellent for the evaluation of background exposures

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Modeling Aggregate Exposures

- Determination of concurrent exposures a chemical from multiple routes and sources
- Who, When, Where, and What?
- Why use modeling for aggregate exposures?

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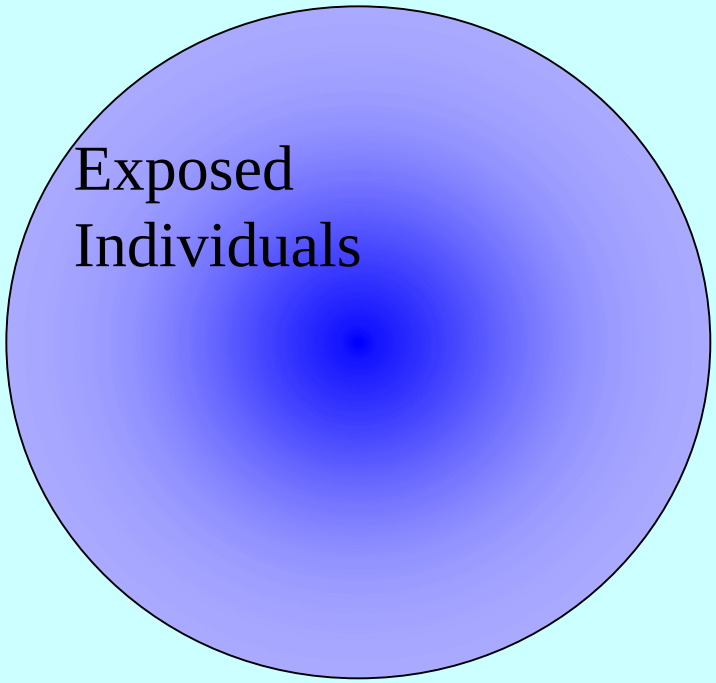
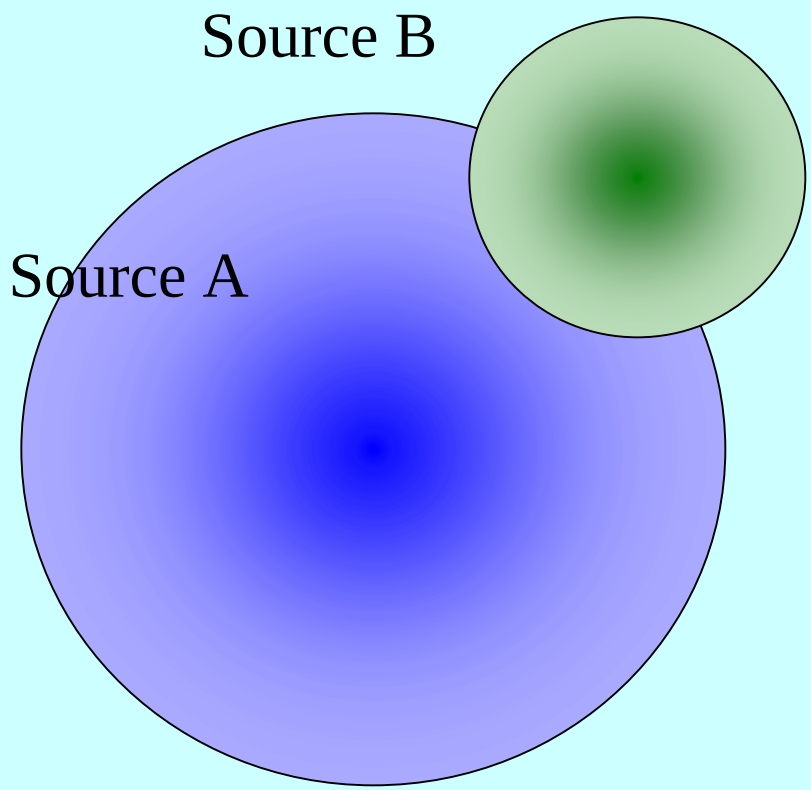
Assessing a Single Source of Exposure



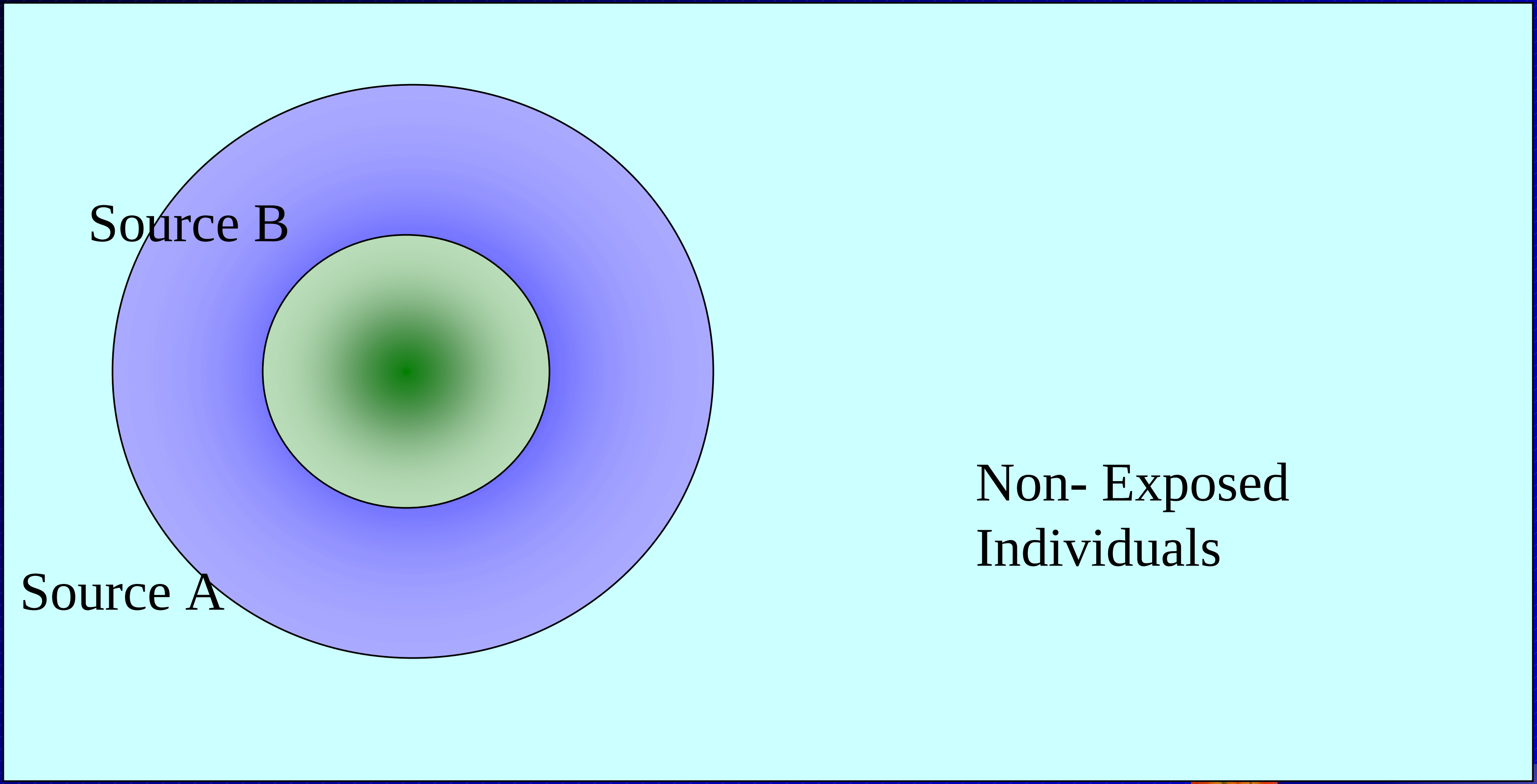
Non- Exposed
Individuals

Aggregate Exposures from Two Independent Sources of Exposure



Non- Exposed Individuals

Characterizing Aggregate Exposure Using Conservative Assumptions



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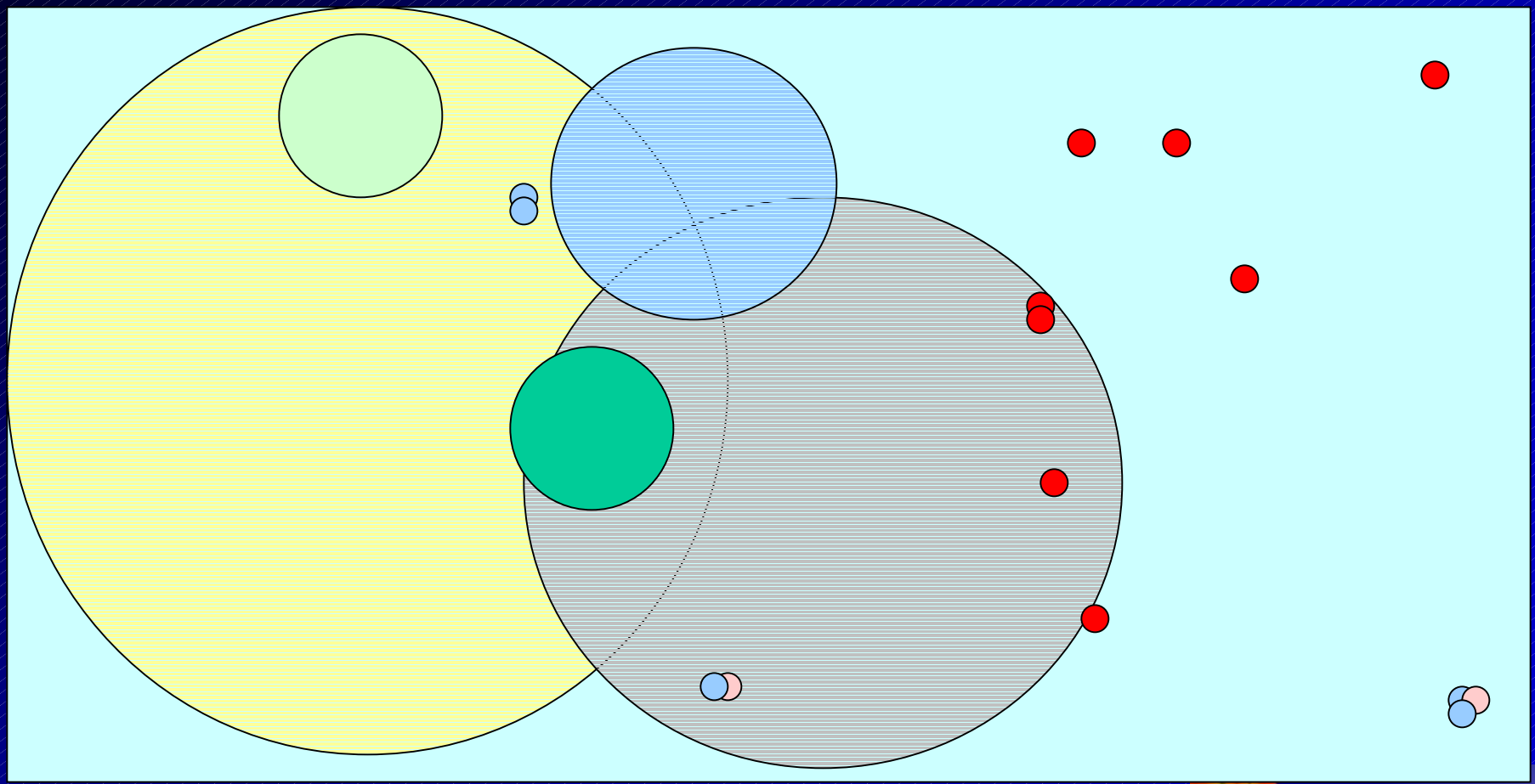
Reality for Many Chemicals



Options for Assessing Aggregate (Multi Route-Multi source) Exposures

- **Use of conservative approaches leads to difficulties**
  - **Conservative addition of exposure from multiple sources becomes less and less plausible as the number of sources increases**
  - **Limits the ability to manage risk**
- Computer modeling of concurrent exposures
  - Survey-based approach
  - Simulation modeling

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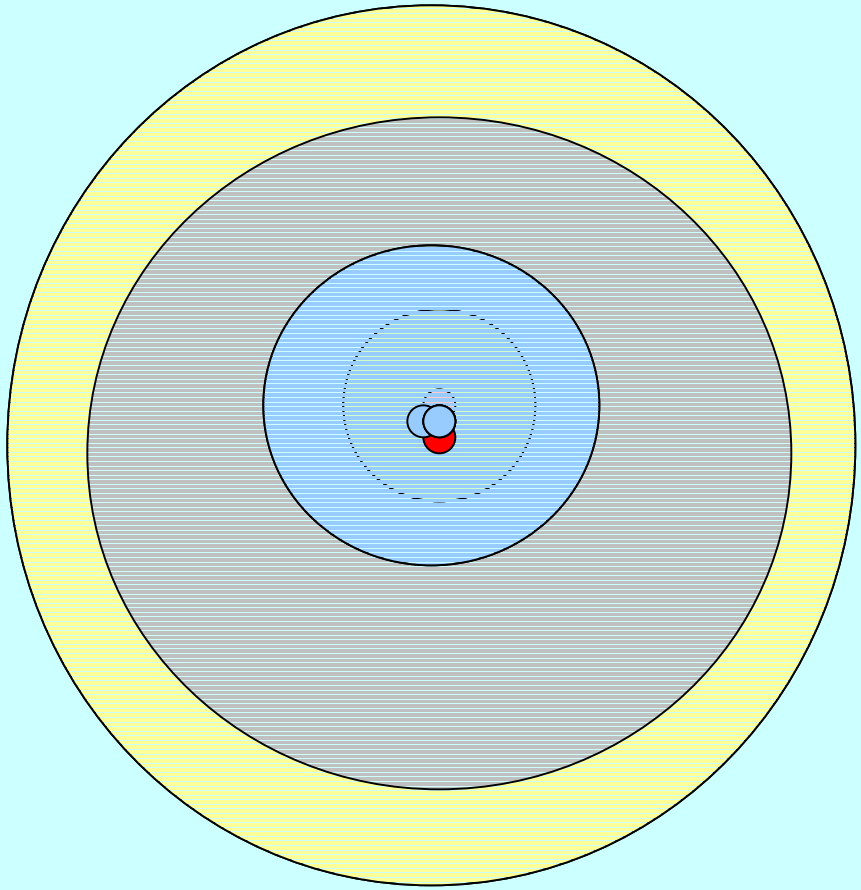
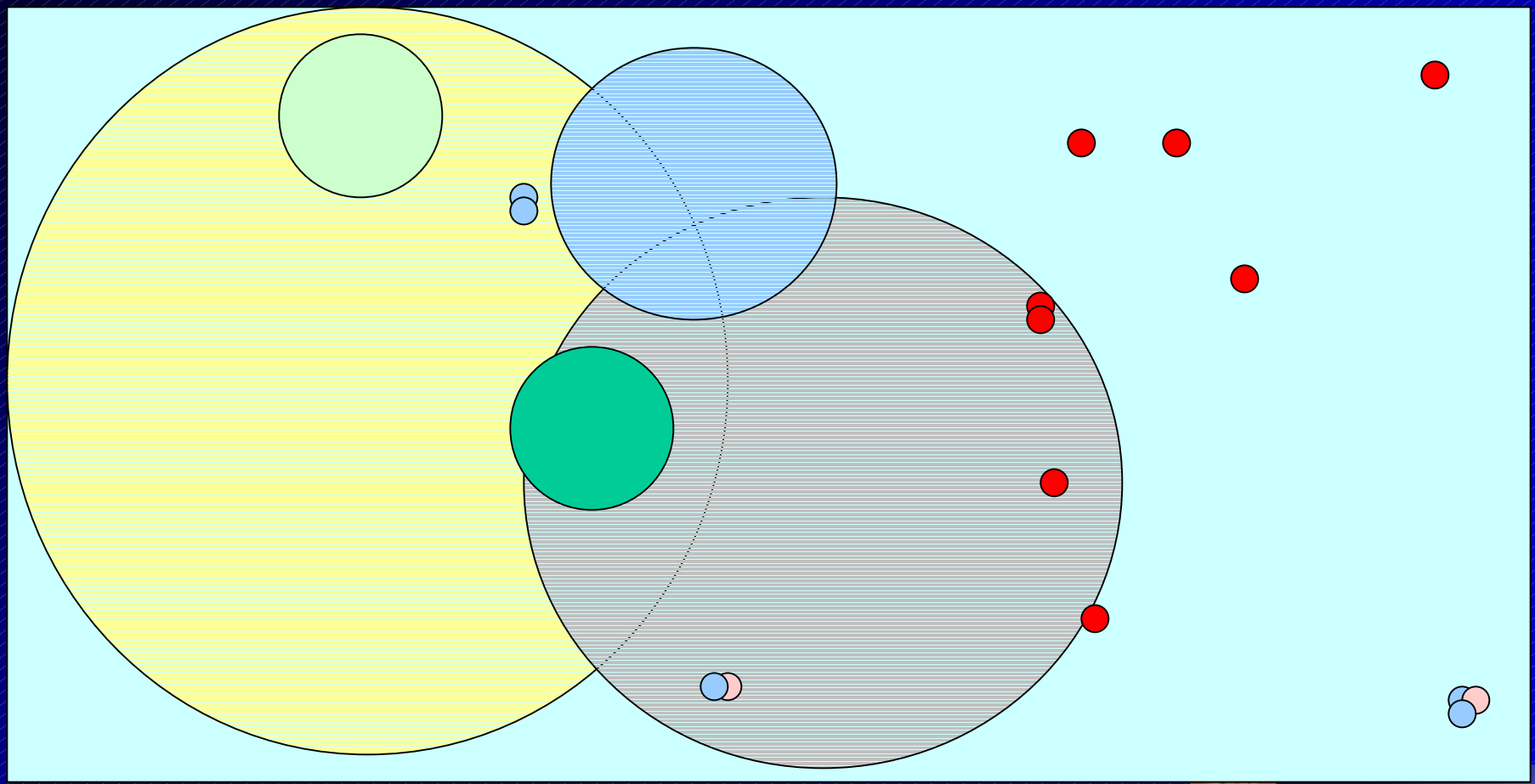
Using Conservative Assumptions for Sixteen Sources



Only Certain Sources Overlap



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Options for Assessing Aggregate (Multi Route-Multi source) Exposures

- Use of conservative approaches have difficulties
  - Conservative addition of risk from multiple products becomes less and less plausible as the number of sources increases
  - Limits the ability to manage risk
- **Computer modeling of concurrent exposures**
  - **Survey-based approaches**
  - **Simulation modeling**

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Survey-Based Approaches

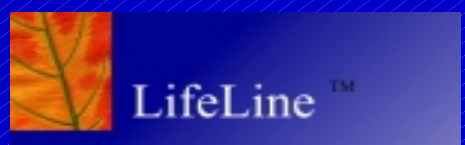
- A single survey determines what a person's concurrent exposures are on a given day
  - Market basket surveys
  - Duplicate dietary surveys
- Basis of the existing dietary models
  - All foods consumed on a given day by one individual
- This approach is difficult to:
  - Extend to non-dietary sources of exposure
  - Determine for multiple days

Simulation Modeling

- Create a model of the entire population (exposed and unexposed) using data from multiple surveys of the target population
- Model the population individual-by-individual
- Model each day of each individual's life for one year or longer
  - Determine the exposure or absence of exposure to each source
  - Determine the resulting dose
  - Sum to give the total daily dose
- The distribution of total dose across individuals provides a model of the target population

Aggregate Exposure Models

- Regulatory support models
  - Calendex™ (Limited Availability)
  - Lifeline™ (Available)
  - CARES™ (Available 2002)
  - TRIM (Available 2002/3)
- Research models
  - MENTOR
  - SHEDS (2002/3)



Aggregate Exposure Models

- All of the models can be run as screening and as refined models
- All are probabilistic
- All are acute-1 year
- LifeLine is the only model that does lifetime
- Diet and tapwater modeling can be applied to any chemicals
- Aggregate framework in place for other sources but:
  - Residential limited to pesticides
  - Difficult to integrate localized sources of exposure

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Models and Children's Exposures

- Screening level models
  - EFAST, CONSEXPO
- Indoor air
  - Screening level MCCEM, PROMISE
  - Advanced IAXQ, TEM
- Local sources of contamination
  - CalTOX, SmartRisk
- Current aggregate models
  - Strong ability for diet and tapwater
  - Weaker for local sources and non-pesticides

Summary

- A wide variety of models are currently available or under development
- Models are relevant to specific sources of exposure and allow both screening and refined assessments
- Conceptual framework for aggregate exposure models has been established
- Aggregate models addressing many, but not all, sources are under development